MONTANA TEEN DRIVER CURRICULUM GUIDE

Module 5.4 – Managing Risk with Vehicle and Highway Design - Lesson Plan

Student Objectives:

The student investigates features built into highway and vehicle design for crash survival and describes how improved technology helps reduce risk and minimizes the consequences of a crash. The student recognizes the types of collisions that can occur and actions that can be taken to control the consequences.

The student is expected to describe:

- the crash survival features incorporated into highway and vehicular design;
- collision types and actions to control the consequences of a crash;
- how improved highway and vehicle technology helps minimize the consequences of a crash.

Materials Needed:

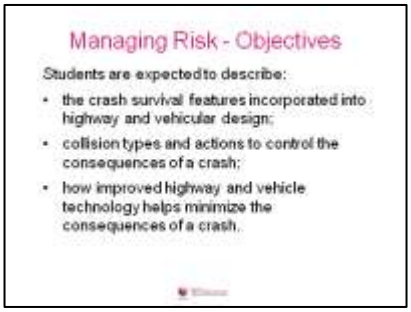
1. **Module 5.4 PowerPoint Presentation**
2. **Module 5.4 Fact and/or Work Sheets (printed for each student)**
3. **Module 5.4 Lesson Plan/Teacher Commentary (printed out)**

TEACHER COMMENTARY	Representation of the module slides are provided to allow you to connect the materials, data, and questions with the presentation.
The following are questions you can ask during the presentation to engage students and have them develop key concepts related to Managing Risk with Vehicle and Highway Design.	

Slide 2 – Managing Risk - Objectives

Students are expected to describe:

- **the crash survival features incorporated into highway and vehicular design;**
- **collision types and actions to control the consequences of a crash;**
- **how improved highway and vehicle technology helps minimize the consequences of a crash.**



Slide 3 – Vehicle and Highway Risks

How Crashes Happen – "The road traffic system consists of three parts: the road and wider environment, the vehicle, and the individual (road user). The characteristics of these components and the interaction between them affect road traffic crashes and the resulting injuries. For example, a person who is driving on a road that is unlit, in a car that has bad brakes, or without wearing a seatbelt is more likely to be seriously injured than someone who is driving on a well-lit road, in a car that is in good condition, and is buckled up."

Source: Youth and Road Safety Action Kit, YOURS – Youth for Road Safety (www.youthforroadsafety.org) MT Photos from MDT and OPI

Slide 4 – Is driving safe or dangerous?

Discuss risk perception:

- **Am I focused on the right risks?**
- **How do I know?**
- **What will happen if I'm wrong?**

Slide 5 – Do you know someone who crashed?

Personal exposure to crashes.

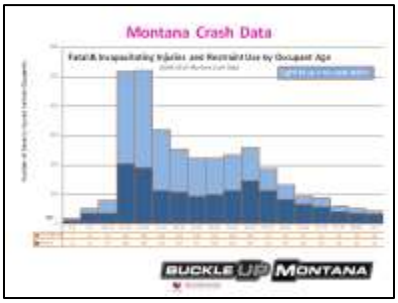
AAA 2012 Traffic Safety Culture Index (AAAFTS.org)

Slide 6 – Montana Crash Data

Montana Seat Belt Use - Preliminary reports for 2011 show that of the 172 vehicle occupant deaths, 127, or almost 74 percent were not wearing seat belts.

In December 2011 alone, of the 18 who died in crashes, 17 were not wearing a seatbelt.

Data Source: Montana Department of Transportation 2011



Slide 7 – Teen drivers are inexperienced

One risk factor to teens is their lack of driving experience. The longer they drive, the more that risk drops. It's clear: crashes drop sharply after 6 months and 1000 miles of licensure. However, the crash risk among younger drivers remains twice that of adults until age 25.
AAAFTS, 2011 Measuring Changes in Teen Crashes During Early Months of Independent Driving

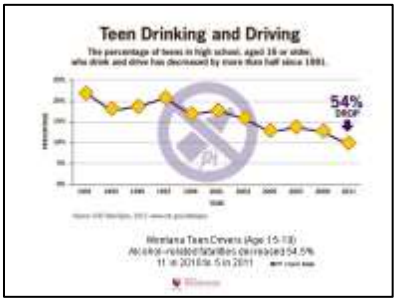
Teen drivers are 50% more likely to crash in the first month of having a license than they are after a full year of experience. Drivers in their first month are nearly twice as likely to crash as they are after two years' experience.

57% of crashes in which a teen was partially responsible during the month involved three common mistakes – failure to reduce speed, inattention, and failure to yield.

Slide 8 – Teen Drinking and Driving

Do you think driving while impaired by alcohol or drugs increases your RISK of a crash?

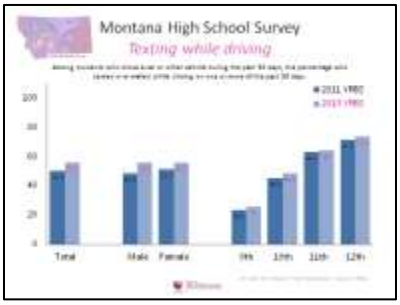
Vehicle and highway designs can make roads safer, but only YOU can choose to drive impaired or not.



Slide 9 – MT High School Survey – Texting while Driving

Do you think texting while driving increases your RISK of a crash?

Again, vehicle and highway designs can make roads safer, but only YOU can choose to drive distracted or not.



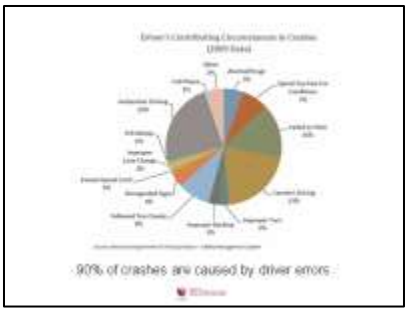
Slide 10 – Teen Drivers Risk Death with Young Passengers

Do you think driving with a lot of passengers increases your RISK of a crash?

What can you do to make sure you drive undistracted by too many passengers?

Slide 11 – Driver's Contributing Circumstances in Crashes

90% of crashes are caused by driver errors.

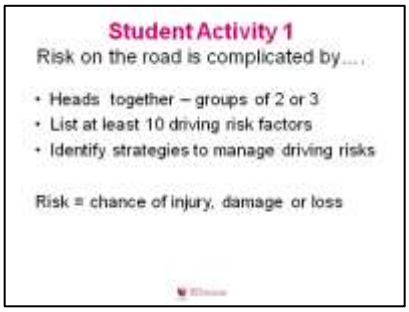


Slide 12 – Student Activity 1

Student Activity – Use the Risk Factors Worksheet and balls of different sizes/shapes.

Have students select several numbers from the list of typical risks and errors.

Toss balls to one student to represent an assortment of risks which can be handled one at a time, but are fumbled when there are many simultaneous risks. Discuss strategies to manage risks while driving.



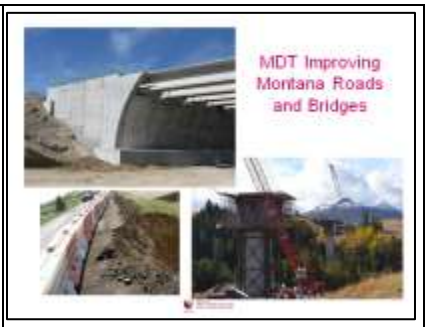
Slide 13 – Engineering Road Safety Solutions

"Systems engineering is the art and science of developing an operable system that meets requirements within imposed constraints. Systems engineering is holistic and integrative. Systems engineering is first and foremost about getting the right design - and then about maintaining and enhancing its technical integrity, as well as managing complexity with good processes to get the design right." - Excerpt from "The Art and Science of Systems Engineering" http://spacese.spacegrant.org/

Slide 14 – Montana Department of Transportation (MDT) Improving Montana Roads and Bridges

Two Medicine MT Bridge construction October, 2011 MDT photo

West Bozeman Interchange bridge beam placement, 2013



Slide 15 – Proven Safety Countermeasures

Research has identified proven safety countermeasures for roads and highways which can be found throughout Montana.

Discuss strategies to reduce roadway departure crashes – many are caused by driver errors.

Slide 16 – Cable barriers, roundabouts, and more

- **Cable median barrier installed to reduce crossover crashes**
- **Rock fall barrier near Harrison, MT**
- **Fog lines and rumble strips on side and center of two lane roads**
- **Roundabouts reduce intersection crashes**
- **Flashing yellow left-turn arrows**

Slide 17 – Technology: Driving the Development of Safer Cars

The Insurance Institute for Highway Safety (IIHS) crash avoidance features are rapidly making their way into the vehicle fleet. Six of the most common new technologies are forward collision warning, auto brake, lane departure warning, lane departure prevention, adaptive headlights and blind spot detection.

Research continues to study how drivers respond to in-vehicle safety messages – audible, visual warnings and haptic feedback (see definition at right).

Watch the IIHS video of the 1959 Bel Air and 2009 Chevy Malibu (link on Slide 19).

Haptic technology, or haptics, is a tactile feedback technology which takes advantage of the sense of touch by applying forces, vibrations, or motions to the user.[1]

Slide 18 – Collision Types

<u>Head-on crash</u> - simulated semi trucks.

<u>Side crash</u> – 1998 GMC Sierra green truck hit at 45+ mph by blue Jaguar – seat belt use saved both drivers and one passenger. One broken wrist, bruises and two totaled vehicles.

<u>Rollover crash</u> – teen driving too fast on a curve at night. F250 crew cab truck rolled over 4 times. Seat belt use and rollover safety cage saved teen who suffered broken ankle and TBI – Traumatic Brain Injury.

<u>Montana young drivers survived in these crashed pickup trucks due to seat belt use and rollover safety cage.</u>

Physics – a collision is an event where momentum or kinetic energy is transferred from one object to another. There are two general types – elastic and inelastic

- **Elastic – two objects bounce apart – example two rubber balls.**
- **Inelastic – two objects collide and do not bounce away from each other.**

A car bumper at low speeds conserves both momentum and kinetic energy to reduce damage. In a low speed collision, the kinetic energy is small enough that the bumper can deform and then bounce back, transferring all the energy directly back into motion. Almost no energy is converted into heat, noise, or damage to the body of the car, as it would in an inelastic collision at higher speeds.

http://www.volpe.dot.gov/sites/volpe.dot.gov/files/Truck_two_semitrucks_in_head-on_collision.jpg

Slide 19 – 1959 Chevrolet Bel Air vs. 2009 Chevrolet Malibu – CRASH TEST

40 mph frontal offset crash test 1959 and 2009 crashworthiness then and now.

Watch the IIHS crash test at http://www.iihs.org/iihs/about-us/milestones/50th-anniversary

Slide 20 – Crash Forces and Consequences

<u>Crashing and Smashing</u>
Extending the time of impact is the basis for many of the ideas about keeping people safe in crashes.
List three applications in vehicle or highway safety:
1. crumple zones, 2. airbags, 3. break-away light poles

Conserving Momentum and Energy - It's the Law!

In a collision of two cars of unequal mass, the occupants of the lighter car would experience much higher accelerations, hence much higher forces than the occupants of the heavier car.

Motion-related energy is called kinetic energy. Energy due to an object's position or conditions is called potential energy.

At what point in the pendulum's swing is its potential energy equal to its kinetic energy? (mid-point)

When is its kinetic energy at its maximum? (bottom)
Circle the correct formula for kinetic energy (KE).

Slide 21 – Driving Safely

What are the risks facing young teen drivers?
- **Inexperience**
- **Speed**
- **Distractions**
- **Fatigue**
- **Alcohol is involved in about 16% of fatal crashes involving 16- and 17-year-old drivers.**

These factors cause crashes, but what kills?
Not wearing a seat belt …

Slide 22 – Plan2Live and other resources

Plan 2 Live
Myth Crashers
TZD – Toward Zero Deaths
MDT's new initiative: Vision Zero

Slide 23 – Highest Lifetime Risk in the First Year

Support greater parent involvement in the learning to drive process. Montana requires 50 hours of parent supervised driving. According to a recent naturalistic study, parents know their teens need lots of practice during the learner phase, but cannot articulate specifics.

Parents typically cover vehicle handling and maneuvering skills under benign conditions (i.e., little to no traffic, nice weather) but do not teach skills such as scanning for hazards or regulating speed for driving conditions. CHOP research shows these skill deficits lead to a significant portion of driver error-related teen crashes.

Parents also need to have their teens practice in a variety of settings, including with commuter traffic, on rural and urban roads, and in inclement weather. Share the study with policymakers to advocate for greater parent involvement in the learning to drive process.

Support driver education/training policies that bolster the role of driver ed instructors (DEIs). In this expanded role, DEIs could continue to teach teens driving skills, as well as supervise parents in practicing those skills and promote the deliberate interaction between DEIs, parents, and teens to ensure new skills are assessed at each stage and mastered before the teens advance toward licensure.

Slide 25 – Will your next car or truck drive itself?

Illustration from US Department of Transportation www.its.dot.gov Research and Innovative Technology Administration

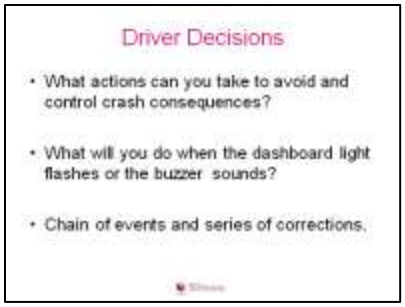
When self-driving cars encounter complex situations like work zones, the vehicle control shifts to the driver, who may be inattentive.

LIDAR – Google' s self-driving car project employs Velodyne's rooftop Light Detection and Ranging system which uses 64 lasers, spinning at upwards of 900 rpm to generate a point cloud that gives the car a 360 degree view. Car is constantly acquiring targets. Analyzes and predicts the world 20 times a second. Relies on roadway marking and road rules.

Connected Vehicle Safety Pilot Program supports development of safety application based on vehicle–to-vehicle V2V and vehicle to infrastructure.

Slide 26 – Driver Decisions

- **What actions can you take to avoid and control crash consequences?**
- **What will you do when the dashboard light flashes or the buzzer sounds?**
- **Chain of events and series of corrections.**



Slides 27-28 – Review of driving risks that need good judgment

Slide 29 – 5-star drivers, 5-star vehicles, 5-star roads

Slide 30-31 – Standards and Benchmarks

Standards and Benchmarks 1-8: This is for your reference and not to be read to the class verbatim. Please review prior to the lesson so you are aware of what the student will be required to know at the end of the module.